JWARP> Vol.2 No.11, November 2010

OPEN ACCESS

Measuring Ice Thicknesses along the Red River in Canada Using RADARSAT-2 Satellite Imagery

PDF (Size:1632KB) PP. 923-933 DOI: 10.4236/jwarp.2010.211110

Author(s)

Karl-Erich Lindenschmidt, Gerry Syrenne, Robert Harrison

ABSTRACT

The spring flood of 2009 in the Red River Valley was exacerbated with severe ice breakup and ice jamming. To assist ice jam mitigation by cutting and breaking up the river ice cover before the flood season and to support the operation of the Red River Floodway, Manitoba Water Stewardship is striving to model the occurrence of ice breakup and simulate the behaviour of ice jamming along the river. An important parameter in ice breakup forecasting is the ice thickness. RADARSAT-2 standard satellite images were collected along the course of the Red River in Manitoba during the 2009-2010 winter to help determine ice thicknesses along the river. Standard images can have transmit-receive polarizations in the horizontal-horizontal (HH) or horizontal-vertical (HV) configurations. Ice thickness measurements were taken in the field during the same time frame when the satellite passed over the Red River Valley. Good correlations were obtained between the HH-backscatter readings and the surveyed ice thicknesses. HV-backscatter readings correlate better with fresh snow depth measurements. Additionally, using same sensor incident angle and flight geometry allows ice thickening rate behavior over the course of the winter to be determined.

KEYWORDS

Ice Jams, RADARSAT-2, Red River, River Ice Thickness, Snow Cover Depth

Cite this paper

K. Lindenschmidt, G. Syrenne and R. Harrison, "Measuring Ice Thicknesses along the Red River in Canada Using RADARSAT-2 Satellite Imagery," *Journal of Water Resource and Protection*, Vol. 2 No. 11, 2010, pp. 923-933. doi: 10.4236/jwarp.2010.211110.

References

[1] M. P. Lacroix, T. D. Prowse, B. R. Bonsal, C. R. Duguay and P. Ménard, "River Ice Trends in Canada," Proceedings 13th Workshop on the Hydraulics of Ice Covered Rivers by CGU HS Committee on River Ice Processes and the Environment (CRIPE), Hanover, New Hampshire, 15-16 September 2005.

[2] B. R. Bonsal and T. D. Prowse, "Trends and Variability in Spring and Autumn 0℃-Isotherm Dates over Canada," Climatic Change, Vol. 57, No. 3, 2003, pp. 341-358.

[3] S. J. Jones "A Review of the Strength of Iceberg and Other Freshwater Ice and the Effect of Temperature," Cold Regions Science and Technology, Vol. 47, 2007, pp. 256-262.

[4] E.M. Schulson, "The Structure and Mechanical Behavior of Ice," Journal of the Minerals, Metals & Materials Society, Vol. 51, No. 2, 1999, pp. 21-27.

[5] B. T. Tracy and S. F. Daly, "River Ice Delineation with RADARSAT SAR," Proceedings of the 12th Workshop on River Ice, Edmonton, Alberta. 2003.

[6] F. Weber, D. Nixon and J. Hurley, "Semi-Automated Classification of River Ice Types on the Peace River Using RADARSAT-1 Synthetic Aperture (SAR) imagery," Canadian Journal of Civil Engineering, Vol. 30, No. 1, 2003, pp. 11-27.

[7] H. Drouin, Y. Gauthier, M. Bernier, M. Jasek, O. Penner and F. Weber, "Quantitative validation of

• Open Special Issues
• Published Special Issues
• Special Issues Guideline

JWARP Subscription

Most popular papers in JWARP

About JWARP News

Frequently Asked Questions

Recommend to Peers

Recommend to Library

Contact Us

RADARSAT river ice maps," Proceedings of the 14th Workshop on River Ice, Québec, 2007.

[8] K.D. Pelletier, J. van der Sanden and F. E. Hicks, "Synthetic aperture radar: current capabilities and limitations for river ice monitoring," Proceedings of the 17th Canadian Hydrotechnical Conference, Edmonton, Alberta, 17-19 August 2005, pp. 1-10.

[9] Y. Gauthier, F. Weber, S. Savary, M. Jasek, L. M. Paquet and M. Beriner, "A Combined Classification Scheme to Characterise River Ice from SAR Data," EARSel eProceedings, Vol. 5, No. 1, 2006, pp. 77-88.

[10] M. Jasek, F. Weber and J. Hurley, "Ice Thickness and Roughness Analysis on the Peace River using RADARSAT-1 SAR Imagery," Proceedings of the 12th Workshop on River Ice, Canadian Geophysical Union—Hy- drology Section, Communication on River Ice Processes and the Environment, Edmonton, Alberta, 18-20 June 2003, pp. 50-68.

[11] K. D. Unterschultz, J. van der Sanden and F. E. Hicks, "Potential of RADARSAT-1 for the Monitoring of River Ice," Cold Regions Science and Technology, Vol. 55, 2009, pp. 238-248.

[12] J. J. van der Sanden, H. Drouin, F. E. Hicks and S. Beltaos, "Potential of RARARSAT-2 for the Monitoring of River Freeze-Up Processes," Proceedings of the 15th Workshop on River Ice, CGU HS Committee on River Ice Processes and the Environment, St. John's, Newfoundland and Labrador, 15-17 June 2009, pp. 364-377.

[13] CCRS, "Fundamentals of Remote Sensing," Canada Centre for Remote Sensing, 2009.

[14] M. Hallikainen and D. P. Winebrenner "The Physical Basis for Sea Ice Remote Sensing," In: F. Carsey, Ed., Microwave Remote Sensing of Sea Ice, American Geophysical Union Geophysical Monograph, Washington, D.C., 1992, pp. 29-46.

[15] S. Sandven and O. M. Johannesen "Sea Ice Monitoring by Remote Sensing," In: J. F. R. Gower, Ed., Manual of Remote Sensing: Remote Sensing of the Marine Environment, 3rd Edition, Vol. 6, American Society for Photogrammetry Remote Sensing, Bethesda, 2006, pp. 241- 283.

[16] D. G. Barber, D. G. Flett, R. A. de Abreu and E. F. LeDrew, "Spatial and Temporal Variation of Sea Ice Geophysical Properties and Microwave Remote Sensing Observations: The SIMS'90 Experiment," Arctic, Vol. 45, No. 3, 1992, pp. 233-251.

[17] M. M?kynen, "Investigation of the Microwave Signatures of the Baltic Sea Ice," Dissertation at Helsinki University of Technology, Espoo, Finland, 2007.